instability in which, among other contributing factors, cross-breeding may perhaps play a part—arouses little misgiving.

The definitions of genera, of which there are 140, and of species, of which there are 406, are polished, and can be read without fatigue, and conspicuous attributes and suggestive relations are effectively summarised. The text-figures illustrating genera are for the most part very clear and good.

(6) The construction of this monumental work goes steadily on, to the infinite honour of its author.

This thirteenth volume, of more than 600 pages, represents two subfamilies, and part of a third, of the great group Noctuidæ. The species included are of Catocalinæ 379, bringing up the total number for the subfamily to 1022, of Mominæ 74, and of Phytometrimæ 226.

The key to the Catocalinæ is reprinted from vol. xii., for convenience. This key, with its clear dichotomies for no fewer than 109 genera, as well as similar keys to the species of the larger genera, embracing some 26, some 40, and one even 101 species, enables the casual critic to form some idea of the prodigious amount of attentive labour embodied—one might almost say enshrined, when one considers that this is an ordered part of a monument *aere perennius, pyramidum altius*—in this volume.

The illustrations are on a generous scale; in addition to 455 beautiful coloured figures, in eighteen plates separately bound, there are 130 figures in the text, so that every genus is represented at least once.

SIX ESSAYS ON SEX.

(1) *Ursprung der Geschlechtsunterschiede.* By Dr. Paul Kammerer, in Fortschritte der Naturwissenschaftlichen Forschung. Herausgegeben von Prof. Emil Abderhalden. Bd. V., pp. 1–240. (Berlin and Vienna, Urban and Schwarzenberg, 1912.) Price 15 marks.

(2) *Die biologischen Grundlagen der sekundären Geschlechtscharaktere.* By Dr. J. Tandler and Dr. S. Grosz. Pp. 169. (Berlin: Julius Springer, 1913.) Price 8 marks.

(3) *Sex Antagonism.* By Walter Heape. Pp. 217. (London: Constable and Co., Ltd., 1913.) Price 7*s*. 6*d*. net.

(4) *The Nature and Origin of Secondary Sex Characters.* By F. W. Ash. Trans. North Staffordshire Field Club. xlvii. (1913), pp. 79–93.

(5) *Les Problèmes de la Sexualité.* By Prof. Maurice Caullery. Pp. 332. (Paris: Ernest Flammarion, 1913.) Price 3.50 francs.

(6) *Heredity and Sex.* By Prof. T. H. Morgan. Pp. ix + 282. (New York: Columbia University Press; London: Oxford University Press, 1913.) Price 7*s*. 6*d*. net.

(1) DR. KAMMERER has made all students of the biology of sex his debtors by taking a scholarly and critical survey of most of the recent contributions to the subject, and of the experimental work in particular. His treatise is a model of fairness and thoroughness, and must have involved a prodigious industry. He deals with the determination of sex, the theories of sex dimorphism, the results of experiments in castration, regeneration, transplantation, breeding, and environmental influence, and at very considerable length with the recent work on the internal secretions of the reproductive organs. The bibliography occupies twenty-three pages of small type! An attempt may be made to indicate Kammerer's general conclusions. The first important step in the evolution of sexual reproduction was the specialising of germ-cells as distinguished from body-cells. The second was the differentiation of macrogametes and microgametes, which are contrasted in their assimilation capacities, amount of cytoplasm, size, and activity. The factors that condition maleness ("mikrogametismus") or femaleness ("makrogametismus") are ultimately assimilation differences—the thesis, it may be recalled, of "The Evolution of Sex" (1889), to which no reference is made in text or bibliography. The differentiation of sex doubtless occurred very early in phylogeny, and the determination of sex occurs correspondingly early in ontogeny. During maturation the gametes are probably in varying degrees susceptible to environmental influence, so that their predisposition to one sex or the other may be changed, but the higher the animal the less is its susceptibility. Only in plants and in the lower animals can we now succeed in experimentally changing the progamic predisposition, activating the tendency which should otherwise remain latent.

Removal of the essential gonads changes the metabolism of the body, and is usually followed by a degeneration of the subsidiary sex characters. But it is practically impossible to draw a definite line between sex characters and body characters. It seems as though the body were "sexed" through and through. The castration, however early, never prevents the appearance of the embryonic primordium of any character; it merely exerts a quantitative influence on the development. When the essential gonadial substances are introduced by transplantation or injection into a castrated animal, the effects of castration are alleviated or reversed, and what can be done with ovarian substance can also be done with testicular substance. It is an extraordinary fact that injection of the gonadial substance, or even cerebral substance, of animals in heat (of males especially), may be followed in castrated animals by sexual excitement and symptoms of heat. The eroticised brain is to be regarded as a regulator, which quickens or retards the growth of certain parts by its effect on the blood-vessels, and also affects the tonus of other ganglia.

Kammerer goes on to show that sex characters behave in inheritance like specific or racial characters; they illustrate either blended or alternative inheritance. Indifferent systematic characters may come to be sex-linked; all sex characters are fundamentally species characters, and all species characters are also sex characters. As we shall point out later, this appears to us to be a sound idea exaggerated into an extravagance. Nor can we accept Kammerer's general Lamarckian theory, for which no convincing evidence is adduced, that sex differences have been environmentally impressed on the passive organism or functionally acquired by the active organism. Our only other criticism of a monumental piece of work is that the author seems to be just a little in a hurry to accept conclusions in regard to the efficacy of the gonadial hormones. Some of Mr. Geoffrey Smith's recent work, which is of the highest importance, seems to indicate that we are not shut up to one interpretation.

(2) The fine work of Tandler and Grosz is in many ways like Kammerer's, but it deals in the main with man and mammals. The authors regard the differentiation of dimorphic gametes as the first and fundamental step in the evolution of sex; somatic dimorphism was a later acquisition. The criterion of a sex character is not so much that it has to do with reproduction, but that it responds variably to the stimulus of the internal secretion of the gonads. Sex characters are not novelties, but specific, or generic, or other systematic characters which have been brought into close correlation with the glands of internal secretion, and with those of the gonads in particular. This thesis is supported by masterly argument, and one is not disinclined to admit that, not only in regard to sex characters, but also in regard to other adaptive characters, it has been the method of evolution to get apparently new things out of the most ancient materials. It will be remembered that Dohrn elaborated this idea in his theory of "Funktionswechsel." But it appears to us that Tandler and Grosz have over-generalised. It may be that the antlers of the stag are masculine exaggerations of a systematic character once common to both sexes (and still shared by both in the reindeer), but we think there are many cases, especially among invertebrates (where we know little of internal secretions), which will not admit of a similar interpretation. Is the pouch of the female marsupial, or the pouch of Nototrema, or the shell of the female Argonaut referable to a systematic character originally common to both sexes? The claspers of Selachians are evolved from portions of the pelvic fins, and to that extent from a character common to the two sexes; but is there any warrant for supposing that ancestral female Selachians had anything definitely corresponding to "claspers"? The same kind of remark may be made in reference to many similar cases, such as the extraordinarily specialised tips of the pedipalps in male spiders. And what shall we say of such familiar sex characters as the scrotum of most male mammals or the ovisacs of many female Copepods?

(3) Mr. Heape is well known as an embryologist and investigator of the physiology of reproduction, and his conclusions on the relations of the sexes are entitled to careful consideration. He is of opinion that the male sexual instincts and requirements are quite different from those of the female; environmental changes affect the two sexes differently; antagonism arises when the natural requirements of the two sexes clash. Thus he regards the present phase of the woman's movement ("the present sex war," he calls it) as primarily a biological phenomenon. "It is obvious that the driving force is engendered by desire to alter the laws which regulate the relations, and therefore the relative power of the sexes." At present the male is disturbed and damaged by being compelled to repress his strong generative impulse; the female is disturbed and damaged because she is leaving, or is forced to leave, the straight path of maternity. This seems to us an exaggeration of the sex factor, and we adhere to the belief that the driving force with the great majority of women interested in the wholesome unrest of to-day is the deliberate and conscious desire to alter those social, economic, and political conditions which have tended in the past to prevent large numbers of women from taking their due share in citizenship. We think that Mr. Heape has done good service in emphasising the deep constitutional differences between man and woman, and we heartily agree with his conclusion that "a woman's usefulness, her value in society, and therefore her power and her happiness, depend not on her likeness to, but on her dissimilarity from man." We maintain, however, that the threads of sex have been caught up and intertwined with so many others that, although the importance of no set of threads can be disregarded, the attempt

to refer this or that movement to purely physiological, or purely psychological, or purely economic factors is a false abstraction.

Of great interest and value, as it seems to us, is the author's contribution to the theory of exogamy and totemism. In a discussion with Dr. Frazer—a model expression of vigorous difference of opinion—Mr. Heape maintains that the origin of exogamy, the cause from which the habit arose, is to be looked for in "the natural desire of the male to seek for his mate outside his own family or clan; while totemism, in so far as it is a more or less elaborate system of restricting the wanderings of the errant male, was probably derived from the opposite sex." To the male the sexual gratification is of more moment; the strange woman is more stimulating; hence exogamy. To the female the consequences of sexual consummation are of more moment; she is at heart a mother with a family; hence totemism, a product of the feminine imagination, which has aided enormously in the consolidation of the family. According to Dr. Frazer, it was in ignorance of the physical significance of paternity that the primitive mother explained to herself the quickening of the child in her womb as due to the entrance of a child-spirit from some external object —a tree or fruit, a beast or bird—the totem. Mr. Heape points out the difficulties in the way of accepting this theory, and especially the difficulty of believing in a primitive ignorance of the part the male plays in generation. He suggests that the superstition was the outcome of the pregnant mother's desire, hope, and finally belief that the virtue of something she admired in the outer world might pass into her child and endow it. This is, of course, the merest indication of the author's thesis, which is admirably defended.

(4) Mr. F. W. Ash propounds the view that male secondary characters are, in general, characters of "abandoned function," corresponding to parts which were functional and developed in both sexes in the comparatively recent ancestry; they develop in the adult male because there is nutritive material to spare, they do not develop in the female because "the surplus growth energy is more directly diverted to provide for a fresh generation." The first part of this theory corresponds to the view of Tandler, Grosz, and Kammerer, that sex characters are derived from systematic characters once common to both sexes; the second part of the theory corresponds to the much-discussed "surplusage theory" of Hesse and Doflein. Towards the end of his paper the author maintains that the differences between the sexes depend on differences in nutrition—which favour anabolic or katabolic preponderance—an interpretation argued for by the authors of "The Evolution of Sex" (1889), and recently rehabilitated by others.

(5) If one wishes a descriptive account of the facts of sex, brought well up to date, one has it in Prof. Caullery's volume. He discusses the gametes, hermaphroditism, sex dimorphism, sexual selection, castration, internal secretions, the determination of sex, Mendelism and sex, parthenogenesis, sex and asexual multiplication, sex in plants, and sex in the simplest organisms. We are not impressed with the arrangement of the book (the author has his own views on this subject), but we are impressed with its clearness, carefulness, and scepticism. It almost overdoes objectivity, and we are not left with an evolutionist picture—probably because the author thinks the times are not ripe. He is convinced, however, that sex is an aspect of the whole organism—dependent primarily, though not always finally, on the physico-chemical constitution of the fertilised ovum; and he leaves us with the conundrum: Does the germ determine the sex of the soma, or does the sex of the soma determine the differentiation of the germ? The answer is that the question is wrongly put.

(6) Prof. T. H. Morgan seeks to link together the results of experimental and cytological analysis. Some of his general positions may be summed up:—Sexual reproduction has been utilised in evolution in the building up of new combinations, but it does not furnish materials for progressive advance; sex determination depends on an internal mechanism, which appears to be the same as that which regulates the distribution of Mendelian characters; sex is due, like any other character, to some factor or determiner contained in the sex chromosomes, of such a kind that when present in duplex it turns the scale so that a female organism results, and that when present in simplex, a male results; sex-linked characters, while following Mendel's principle of segregation, are also undeniably associated with the mechanism of sex—that is, with the behaviour of the chromosomes at the time of the formation of the germ-cells; Darwin's theory of sexual selection is open to serious criticism, for there is no clear proof of choice, and there is lack of evidence that selection could effect the sex differences, which may be due to mutations; the secondary sex characters are not all on the same footing (in insects, for instance, their development is independent of the reproductive organs), and it is not likely that their evolution can be explained by any one theory. The author also deals with gynandromorphism, hermaphroditism, and special cases of sex inheritance; and one of the most valuable chapters in

the book is a discussion of fertility and sterility in the light of recent advances. We have to thank Prof. Morgan for these lucid and scholarly lectures on heredity and sex, which express his characteristic combination of critical judgment and synthetic appreciation. The reader is assisted by the numerous illustrations, many of which are very fresh and interesting.
J. A. T.

OUR BOOKSHELF.

Das Elisabeth Linné-Phänomen (sogenanntes Blitzen der Blüten) und seine Deutungen. By Prof. F. A. W. Thomas. Pp. 53. (Jena: G. Fischer, 1914.) Price 1.50 marks.

THIS small work has the two-fold object of directing the attention of nature-lovers to the pleasing phenomenon of "Flashing Flowers," which is more exactly defined as the Elizabeth Linnæus Phenomenon, and of giving a scientific explanation of its cause.

Perhaps the most interesting feature of the investigation is the names with which it is associated, beginning with Elizabeth Linnæus (daughter of the great Swedish botanist), who first observed the flashing of Indian Cress flowers at twilight in her father's garden at Hammarby, near Uppsala, and published her observation with a comment from Linnæus himself. Her discovery interested a number of scientific men, who ascribed the appearance to electricity, phosphorescence, etc., or rejected it as imaginary and only visible to those who could see ghosts. High above them all stands Goethe, who answered Elizabeth Linnæus's pertinent question "whether the flashing is in the flower or in the eye," by referring to the effect upon the eye of brilliant complementary colours, and by pointing out that the flashing is only seen in a flower which comes sideways into the field of vision.

Prof. Thomas gives an explanation of the phenomenon. It is perceived, he says, in twilight, which makes red brighter and green duller than they appear in full daylight. As the image of the red flower moves from the peripheral part of the retina, where the rods are red-blind, to the fovea, the red is perceived somewhat more vividly than before, and this image coincides with the Purkinje after-image of the surroundings, giving the impression of a flash.
H. W.

Die Wichtigsten Lagerstätten der "Nichterze." By Prof. O. Stutzer. Zweiter Teil: Kohle (Allgemeine Kohlengeologie). Pp. xvi + 345 + xxix plates. (Berlin: Gebrüder Borntraeger, 1914.) Price 16 marks.

THIS second part of Dr. Stutzer's encyclopædic work is entirely devoted to coal and other carbonaceous deposits. The first, or petrographical, division of the volume deals with the chemical and physical characters of coal and the results of its microscopical examination, with a discussion of the theories of the origin of coal. The aim of the author is to bring together the observations and conclusions of all who have written upon the subject, rather than to advocate any particular views of his own. The second division of the work is stratigraphical, and an immense amount of valuable information is collected and classified concerning coal-seams—their modes of occurrence and the indications which they exhibit of operations taking place during and subsequently to their deposition. The third division of the book is statistical, dealing with coal-supply and coal-production in all parts of the globe, full use being made of the important work on "The Coal Resources of the World," which was inaugurated at the meeting of the Geological Congress at Toronto and published last year. Throughout the work before us no effort seems to have been spared by its author in making the information complete and up-to-date. Among the numerous wood-cuts are given many graphic illustrations, which are of the greatest assistance to the reader, as well as copies of figures derived from the works of a great number of different authors. Taken altogether, this second part of Dr. Stutzer's monograph fully realises the high expectations which must have been formed by all who have used his earlier volume.

Descriptive Geometry. Part i., Lines and Planes. By Prof. John C. Tracey. Part ii., Solids. By Prof. H. B. North and Prof. J. C. Tracey. Pp. x + 126. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 8*s*. 6*d*. net.

PERHAPS the most notable feature of this work is its logical development of the subject. Beginning with the point in space we are shown its plan, front elevation, and side elevation, when situated in the various positions relatively to the three planes of projection. Then follows an equally exhaustive treatment of the line and plane. A very complete system of notation, specially suitable for oral instruction as well as for private reading, is carefully defined and strictly adhered to throughout. Also, in the authors' scheme is a unique system of triple columns. In the first column the problem is stated in general terms along with the principles and previous problems involved. In the other two parallel columns we have an illustrative particular case, accompanied by a figure, or by a series of figures exhibiting the successive steps in the solution. The authors give special prominence to three fundamental constructions on which most of the subsequent work is based.

A student who has thoroughly mastered the first part of the book should have little difficulty with the second, which deals with some of the simpler geometrical solids; their projections when situated in easy and in difficult positions; their sections by vertical, inclined, and oblique planes; the development and intersection of their surfaces; and the determination of lines and planes tangential to them.

The general treatment is purposely somewhat abstract, being unrelieved by practical problems or applications. The authors, however, propose to issue later a complete set of exercises for use with this very thorough and sound work on descriptive geometry.